Quest Engineering & Failure Analysis, Inc.
www.quest-engineering.com

October 12, 2023

Ms. Tedra Cannella
Cannella Snyder LLC
PO Box 1399
Decatur, GA 30031

Re: FR26 Report

File: Bryson Accident
Quest No: 10519

Dear Ms. Cannella:

This report presents background information, our observations, analysis, and opinions regarding the subject accident. The purpose of our work was to reconstruct the subject accident. Of specific interest was investigation into the effect of the accident truck's lift modifications.

Background

According to the incident reports, the accident occurred at 11:15 PM on March 15th, 2020 at the intersection of GA 2 and Blue Ridge Dr. (GA 5) in Fannin County, Georgia. The posted speed limit was 55 mph and the intersection was controlled by a traffic signal. The conditions were noted as being dark, cloudy, and dry. A lifted 2016 Ford F250 Super Duty (V1), operated by Hunter Elliot, traveling West in the left travel lane on GA 2. A 2008 Ford Escape (V2), operated by Santana Kelly, was stopped at the intersection in the left travel lane, facing West on GA 2. There were two passengers in the Escape: Joshua Bryson in the front passenger seat and Cohen Bryson in the rear left seat, in a properly restrained child car seat. The F250 struck the rear of the Escape, pushing the Escape into the intersection. Mr. Elliot then backed up his vehicle. The occupants of the Ford Escape were seriously injured and were taken to the hospital. Cohen Bryson, a two-year-old child located in the left rear seat was pronounced deceased as a result of this crash. Reportedly, there were four witnesses at the scene.

Work Performed

Representatives of Quest Engineering inspected and documented the 2008 Ford Escape and 2016 Ford F250 several times between February 2021 and September 2023. We photographed, scanned, and took measurements of both vehicles. We visited and documented the accident scene on July 14, 2023. We have inspected and documented exemplars of each accident vehicle. We were provided or researched the following file materials and resources:

- Georgia Motor Vehicle Crash Report
- Georgia State Patrol (GSP) National Incident-Based Reporting System (NIRBS) report
- Specialized Collision Reconstruction Team (SCRT) report, photos, and videos
- SCRT Orthographic Aerial
- Date of Accident (DOA) photos and videos
- Photos, videos, and notes provided by Plaintiff's counsel
- All written discovery
- Autopsy
- Autopsy photos
- Fannin County Coroner records
- Fannin County EMS records
- Fannin County medical records for Joshua and Santana Bryson
- Erlanger Health System medical records for Joshua Bryson
- Ronnie Thomspon Ford Document Production
- Rough Country's Written Discovery Responses
- Rough Country's Document Productions
- Google Aerial and Streetview Images
- Vehicle specifications for both accident vehicles
- 2008 Ford Escape Owner's Manual
- 2008 Ford Escape Event Data Recorder (EDR) Download
- 2008 Ford Escape CARFAX Vehicle History Report
- 2008 Ford Escape Exemplar Vehicle
- 2016 Ford F250 Owner's Manual
- 2016 Ford F250 EDR Download
- 2016 Ford F250 Infotainment Download
- 2016 Ford F250 CARFAX Vehicle History Report
- 2015 Ford F250 Exemplar Vehicle
- Exemplar Safety 1st child seats
- Order confirmation for the subject lift kit to Will Holloway
- Exemplar Rough Country Lift Kits
- Rough Country Lift Kit Manuals
- National Highway Traffic Safety Administration (NHTSA) Exemplar Escape Crash Test
- Depositions of:
  - Santana Bryson
  - Joshua Bryson
  - Trooper Andrew Phillips

- 30(b)(6) Deposition of Rough Country

In addition, we prepared scale drawings, models, and images depicting the evidence and accident events.

Observations

Based on the inspections of the 2008 Ford Escape:

- The Escape's static rear crush damage extended forward to a depth of 3.66 feet.
- The Escape's rear occupant seat was pushed visibly forward from the impact.
- Impact damage was present on the rear of the Escape demonstrating crush and match points between the F250's:
  - Bumper to Escape hatch
  - Tow hooks to Escape hatch
  - Hood to Escape's D-pillars
  - Hood to Escape's hatch hinges
  - Secondary Energy Absorption System (SEAS) brackets to Escape's bumper and left rear tire
  - Right front tire to Escape's rear
- Impact holes were present near the bottom of the Escape's hatch, about 30 inches apart, from the F250 tow hooks.
- The rear frame near the spare tire attachment point had an approximately 4.5-inch gash, matching the F250 SEAS bracket.
- The tailpipe had tire rub marks and had been bent downward.
- The bumper impact bar was nearly fully detached from the vehicle with a 4.5-inch imprint from the SEAS bracket.
- There was a gap between the rear passenger seat and the hatch which corresponded to trunk contents such as a shop vac and folding chairs in the vehicle.
- The Escape's measured weight was 3,410 lbs. at the inspection on February 22, 2022.
- The rear bumper of the Escape was only slightly bent.

Based on the inspections of the 2016 Ford F250:

- F250 front-end damage was visible on the bumper, grill, and hood.
- F250 crush extended slightly farther back on the right side of the vehicle.
- Two impact marks were present on the top of the hood of the F250, about 28 inches apart which corresponded to the Escape's hatch hinges.
- The F250 has two tow hooks on the front of the bumper, which are 30 inches above the ground.
- The F250 has two SEAS brackets underneath the bumper, about 4.5 inches in width.
  - The brackets' bottom edges are 19 inches from the ground.
- There were perpendicular black transfer marks on the bottom of the F250 bumper which corresponded to the tread cover on the top of the Escape bumper.
- The F250 had an aftermarket Rough Country, "RC", lift kit installed.
- There were no RC lift warning stickers on any of the windows of the vehicle.

- The F250 had a ground clearance of about 10 inches.
- The F250's original ground clearance was 9.25 inches.
- The F250 tires were about half an inch larger radius than stock tires.
- The effective total body lift was 6.1 inches.
- The vehicle's measured weight was about 8,040 lb., at the time of our inspection.

Based on the EDR of the 2016 Ford F250:

- The data was downloaded 20 ignition cycles after the event.
- The recorded speed of the F250 was about 52 mph five seconds prior to airbag deployment.
- The recorded speed of the F250 was 50 mph immediately prior to airbag deployment.
- No ABS activity was recorded from the ABS system.
- The impact Delta-V was 17.92 mph longitudinal and 0.14 mph lateral.
- The principal direction of force was 6 o'clock.
- Because of the vehicles oversized tires, the EDR under reported speed by 1 mph.

Based on Quest's documentation of the accident scene along with accident scene photographs:

- The scene evidence had been painted with blue spray paint by law enforcement.
- Tire marks, gouges and fluid trails also existed which denoted areas of impact, travel, and rest.
- The Escape's spare tire rim left a clear impact mark on the asphalt clearly defining the area of collision.
- The roadway was asphaltic concrete construction.
- The impact was in the left thru lane near the stop bar.
- The Escape was propelled approximately 150ft from impact to rest.

Methodology

Documentation of Vehicular Evidence

The initial effort in accident reconstruction is the documentation and preservation of evidence, where areas of the vehicle that recorded information about the crash are examined, such as crush, paint transfer, and characteristic damage and markings. Several "match points" were identified on each vehicle, which are unique characteristic marks that correspond to unique components or geometry of the vehicles. Marking the match points with different colored bright tape allowed for the correlation of vehicle-to-vehicle damage *(Figure 1)*. The match points on each vehicle were carefully measured and photographed. Similar efforts were expended at the accident scene.

Figure 1: Match points with brightly colored tape

A FARO laser scanner, which collects electronic measurement data about the three-dimensional vehicle, returns a digital 3D point cloud that can be viewed and edited in Computer-Aided Design (CAD) software. In the point cloud of each vehicle, the brightly colored tape that was previously placed on the vehicle at the time of the inspection was readily visible for analysis purposes *(Figure 2).* In addition, the exemplar Safety 1st car seat was scanned. The point clouds allowed accurate matching of corresponding vehicle shapes. The scan of the point cloud is useful for several different engineering analysis purposes.

Figure 2: Brightly colored tape visible on the point cloud models

Vehicle Modeling

The point clouds from the inspections were imported into a CAD software called AutoCAD. In this software, a cross section of a scan can be created at any desired height level, such as the crush region. The crushed region of the Escape was around the bottom of the rear hatch and the F250 crush region was at the bumper level height. The cross section was then viewed in an orthographic 2D top-down view where the perimeter of the cross section can be traced, showing the shape of the permanent crush. The two vehicles were matched by using the drawings of the maximum permanent crush profile of the two vehicles at the corresponding elevation *(Figure 3).*

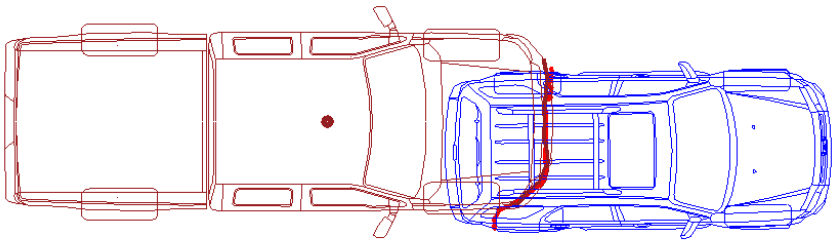


Figure 3: Crush Damage Matching (Static)

The damage profile was placed over an undamaged vehicle drawing, showing the change in the vehicle's shape *(Figure 4).* This was used to determine the amount of crush on the vehicle. In order to compare the damaged vehicle to an undamaged vehicle, an exemplar Ford F250 was inspected and scanned. The F250 inspected was a stock, unaltered, 2015 Ford F250 Super Duty Crew Cab 4x4 Pickup with LT275/70R18 tires. The exemplar was verified by using the Vehicle Identification Number (VIN). An exemplar Ford Escape, which was also stock and unaltered, was also inspected and scanned. The exemplar Escape was also scanned with an exemplar Safety 1st child seat, positioned in the rear left seat. The exemplar for the Escape was a 2010 Ford Escape 4x2 with the same size tires as the accident vehicle (235/70R16). The Escape exemplar was also verified using the VIN.

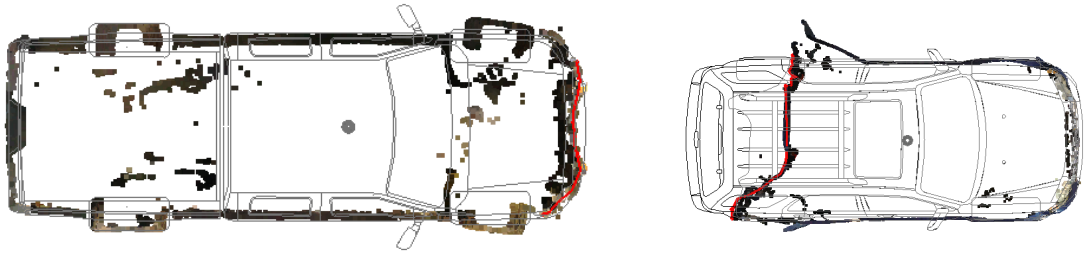


Figure 4: Crush lines from scan cross section

The rear seat of the Escape had been displaced forward significantly. To measure the change in forward distance that the seat had been displaced, the roofs of the subject Escape and the Escape exemplar scans were cropped, revealing the interior of the vehicles. Because the rear seat moved forward, the child seat also moved forward. The exemplar car seat was scanned in the exemplar Escape; therefore, it was visible in the cropped scan. The accident car seat no longer fit in the subject Escape. Using a 3D editing software, CloudCompare, the exemplar car seat was placed in the scan of the accident Escape based on DOA photos. This model was imported into AutoCAD and the roof was cropped, revealing the difference in the forward distance of the child seat. The movement of the head rest area and the bottom of the seat were compared *(Figure 5).*

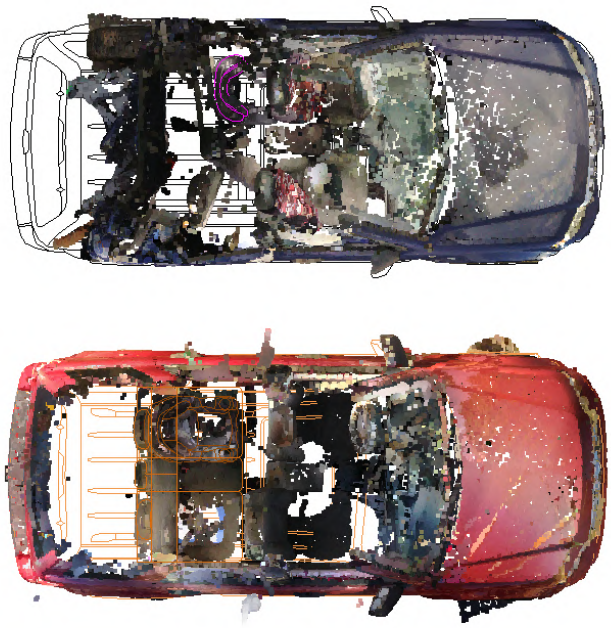


Figure 5: Rear seat and child seat change in position

The difference in height of the F250 was determined by using side views of the F250 in AutoCAD. The scan of the exemplar (stock) F250 was drawn and the subject F250 was drawn. This revealed the height difference between the stock and lifted F250 *(Figure 6).* This was also verified by using measurements of the subject F250 and comparing against the exemplar F250.

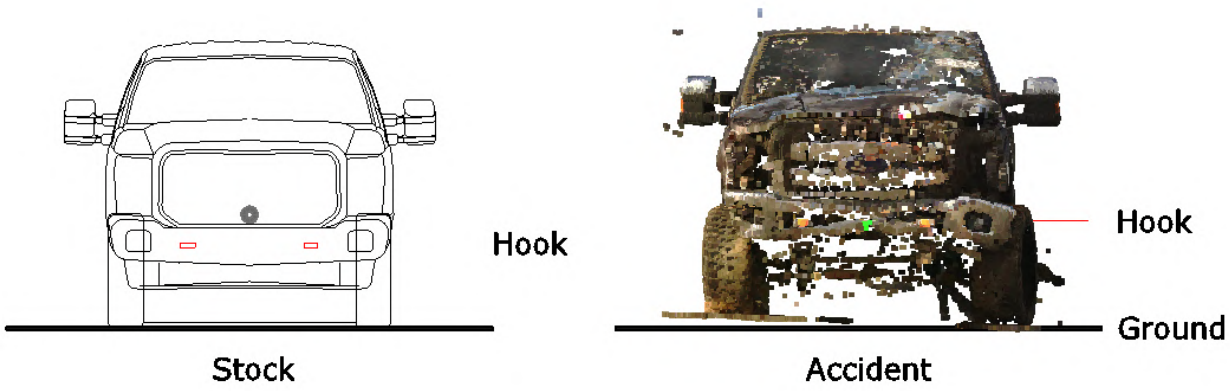


Figure 6: Stock F250 comparison to Accident F250

The point clouds were also used in CloudCompare. In CloudCompare, 3D models (including point clouds) can be viewed, cropped, rotated, and translated. The match points of the vehicles were linked together in 3D space using CloudCompare. This was simplified due to the bright colored tape that was placed on the vehicle at the inspection which showed up on the scan. Primarily, four match points were needed to link the two vehicles together. The hood of the F250 displayed two small rectangular intrusions that were 28 inches apart. The Escape had two protruding hinges that held the top of the rear windshield in place that were also 28 inches apart. In addition, the hinges on the

Escape displayed contact evidence. Based on the measurements, shape, and size of the markings, revealing that this was a match point. In CloudCompare, the two vehicles were matched together based on these two marks *(Figure 7).* Another match point was where the tow hooks of the F250 impacted the rear hatch of the Escape. The F250 has two tow hooks that are located near the center of the bumper. The Escape had a hole immediately to the left side of the bottom of the rear hatch and another hole that was near the right side of the centerline of the vehicle. The analysis revealed that the F250 tow hooks matched the holes of the Escape. Additional match points increased the certainty of the model.

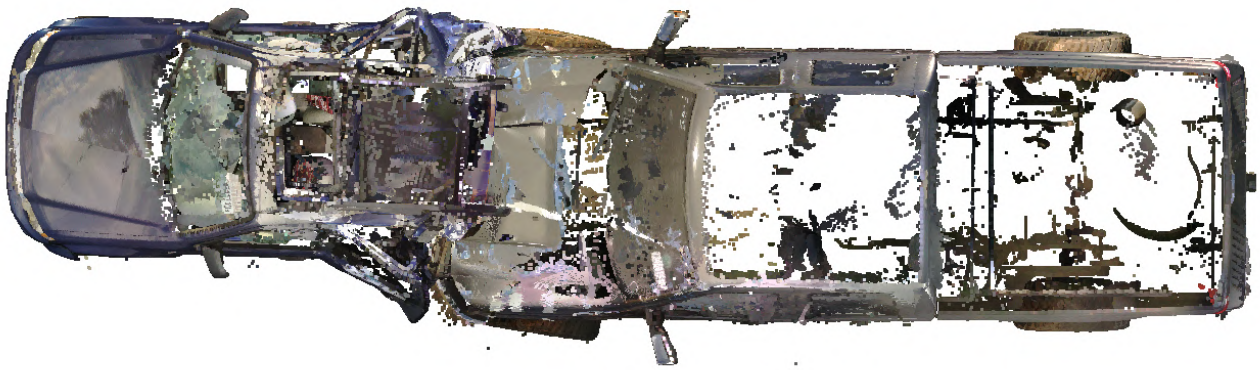


Figure 7: Maximum Engagement modeled in 3D

A gash on the Escape rear matched the geometry and dimensions of the SEAS bracket. At one of the vehicle inspections, an exemplar SEAS bracket was matched with the gash on the Escape's rear. The other SEAS bracket corresponded to the left rear tire of the Escape, which displayed contact damage. Additionally, by using the contact damage, the hood of the F250 impacted the D-pillars of the Escape and the right front tire of the F250 impacted the tailpipe of the Escape. This information was used to validate the maximum engagement of the F250 into the Escape.

A CAD comparison of the post-crash vehicle crush geometries to the deepest penetration match points revealed over ½ foot of dynamic rebound occurred. Thus, the Escape dynamic crush was determined through the comparison of known match points.

F250 ACM Data Analysis

The 2016 Ford F250 was equipped with an Airbag Control Module (ACM). The ACM, which is commonly referred to as a "Black Box," contains electronic crash information. The ACM is capable of storing both pre-crash and crash data, including the speed of the vehicle as it approached the crash, and the change in velocity (delta-V) experienced in the crash. The imaging of the ACM was done on 04/03/2020 using Crash Data Retrieval Tool 19.3.

The ACM recorded one event, which was a deployment event. A deployment event is an event in which airbags or restraint control systems are deployed. Deployment events cannot be overwritten, and the F250 had the capability of storing up to two deployment events. The ignition cycle at the crash was 6,697, only 20 ignition cycles less than when the F250 was imaged (6717 ignition cycles

when imaged). The ACM recorded that the driver of the F250 was not buckled, and the F250 passenger seat was not occupied.

The ACM recorded 5 seconds of pre-crash data, 251 ms (0.251 seconds) of post-crash delta-V data (both lateral and longitudinal delta-Vs). A pre-crash data table is shown below *(Figure 8)*:

BOSCH CDR CRASH DATA RETRIEVAL

Pre-Crash Data -5 to 0 sec [2 samples/sec] (First Record)

Times (sec)	Speed vehicle indicated MPH [km/h]	Accelerator pedal, % full	Service brake, on/off	Engine RPM	ABS activity (engaged, non-engaged)	Brake Powertrain Torque Request	Driver Gear Selection
- 5.0	52 [84]	24.1	Off	1,270	non-engaged	No	Drive
- 4.5	52 [83]	24.3	Off	1,264	non-engaged	No	Drive
- 4.0	52 [83]	24.0	Off	1,262	non-engaged	No	Drive
- 3.5	52 [83]	23.8	Off	1,256	non-engaged	No	Drive
- 3.0	52 [83]	23.7	Off	1,256	non-engaged	No	Drive
- 2.5	51 [82]	23.5	Off	1,254	non-engaged	No	Drive
- 2.0	51 [82]	23.0	Off	1,250	non-engaged	No	Drive
- 1.5	51 [82]	23.0	Off	1,246	non-engaged	No	Drive
- 1.0	51 [82]	23.0	Off	1,246	non-engaged	No	Drive
- 0.5	51 [82]	22.9	Off	1,242	non-engaged	No	Drive
0.0	50 [81]	0.0	On	1,174	non-engaged	No	Drive

Figure 8: ACM Pre-Crash Data table

The ACM recorded longitudinal delta-V of -17.92 mph (17.92 mph backwards) and a lateral delta-V of -0.14 mph (0.14 mph to the left).

The ACM calculates "Speed vehicle indicated" based on how fast the wheels are rotating, assuming the vehicle has the placard tire size. If the vehicle has a different tire size than the placard tire size, the "Speed vehicle indicated" will have to be adjusted based on the ratio between the actual tire size and placard tire size. For the subject F250, the speed adjustment factor is found to be 1.02, which means that the indicated pre-impact speed of 50 mph is actually 51 mph (50mph x 1.02 = 51mph).

Momentum Calculations

The principle of conservation of momentum was used to calculate the post-impact velocity of the 2008 Ford Escape. Conservation of momentum is a principle derived from Newton's laws of motion. Momentum is proportional to vehicle velocity times vehicle weight. Since the weights of both vehicles were measured and the 2016 Ford F250 ACM provided data for the F250 pre-impact speed and delta-V experienced in the collision, enough information was known to use conservation of momentum to solve for the delta-V and post-impact velocities of the Ford Escape.

Crush Analysis

Crush analysis is an application of the law of conservation of energy to determine the closing speed or impact speed if one of the vehicles are stopped. The Escape was stopped at impact, meaning the closing speed was equal to the impact speed of the F250, which is known from ACM data. Since the closing speed was known, there was enough information to use a crush analysis to calculate the amount of crush that would have been caused by the impact if the F250 had hit more of the structural components of the Escape, instead of the Escape hatch.

The crush depth was determined through standard mathematical calculations given the make, model, size, and vehicle type classification of each vehicle, along with the vehicle's geometry. This analysis reveals that if the F250 was not raised, the Ford Escape would have had significantly less crush than occurred in the subject accident.

Simulations

The collision was simulated in HVE (Human Vehicle Environment), a physics-based 3D computer simulation program used in accident reconstruction, using SIMON (Simulation Model Non-Linear). SIMON is a 3D vehicle dynamic simulation model that is used to simulate vehicle-to-vehicle collisions. The program's Ford Escape data was updated for the accident vehicle's weight, which was measured. For the F250, a model from a scan of an undamaged stock F250 was built and updated with the measured weight and the tire size of the subject F250. The simulation did not have its own crush stiffness for an F250, so crush stiffness for the model was obtained from Neptune Engineering, whose data was based on a government crash test. The ACM data from the accident F250 was used as initial conditions and was tuned to match the F250 delta-V. In the simulation of the stock F250, more of the structural areas of the Escape were utilized, reducing the Escape crush. Collision results were reported and the calculated resulting static crush on the Escape was plotted.

Analysis and Conclusions

Using the above information, we performed standard engineering and accident reconstruction analysis which revealed the following information:

- The F250 was effectively lifted over 6 inches.
- In the subject accident the F250 bumper penetrated to beyond the original location of the child seat pushing the child seat's head rest area (Safety 1st logo) forward by over 18 inches to a post-crash rest location of 1.1 feet from the rear of the driver's static seat back location.
- Dynamic analysis and damage matching reveal that during the crash the F250 bumper penetrated 4.36 feet into the rear hatch trunk and rear seat position areas, pushing the child seat's head rest area (Safety 1st logo) forward over 2 feet to a during-crash location only about 6 inches from the driver's static seat back location (top of the seat).
- Had the lift kit not been installed, the stock F250 would have interacted more directly with the stronger structural components of the Escape rear as opposed to the Escape hatch and pillars.

- Had the stock F250 impacted the rear of the Escape at 51 mph and contacted the Escape's bumper and related structural components more directly, reasonably the crush on the rear of the Escape would have been dramatically reduced by near 1/2 or over 2 feet.
- The damage on the Escape matches the F250 damage and features.
- Holes on the F250's hood were created by the hinges on the Escape's hatch that hold the rear windshield in place.
- The F250 bumper overrode the rear bumper of the Escape, directly contacting the rear hatch.
- Had the F250 not been lifted, a more flush contact between the bumpers would not have caused the override.
- The Escape bumper level support structures were largely intact following the crash, some of which had been displaced vertically downward, reducing their effectiveness.
- The F250's speed at impact was near 51 mph with a 17.93 mph Delta-V.
- The Escape's speed at impact was near 0 mph with a 40 mph Delta-V.
- The F250 felt a maximum of 10.4 g's.
- The Escape felt a maximum of near 23.6 g's.
- The left rear occupant position had approximately 1.5 feet of forward static shift and the dynamic shift of the head rest area of the child's seat was approximately 2 feet.
- The front bumper of the F250 penetrated all the way into the left rear seat area such that during the collision, the truck's grill Ford logo was literally positioned over the child seat's original headrest location area.
- Because the Escape's rear hatch, cargo, and rear seat back necessarily had to remain in front of the F250 the child's seat was pushed forward from its original position.
- Front row Escape occupant positions felt similar accelerations to the vehicle as a whole; however, the rear child seat felt multiple times higher accelerations due to its location in the vehicle crush zone.
- The simulation results indicate a stock F250 impact would have resulted in near 45 g's acceleration to the Escape.
- Calculations and simulations of the accident with the F250 at factory height produced collisions that reduced the Escape's crush and resulted in damage which would not have penetrated to the rear seat such that the rear occupant compartment would not have been compromised.

Attached are support materials used in my analysis which support the above information.

My opinions are given within a reasonable degree of engineering certainty. They are based on generally accepted principles of science, engineering, and accident reconstruction, on methodologies generally accepted within the engineering and accident reconstruction communities, and our work to date. To the extent additional evidence becomes available that affects my opinions, I will update my opinions accordingly.

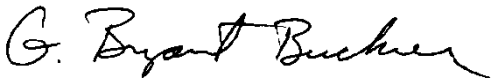
In presenting my opinions to the jury, I anticipate preparing and utilizing the following demonstratives:

- Labeled and annotated photographs and videos identifying key pieces of information.
- Aerial and drone imagery.
- Date of accident photographs and videos.
- Inspection photographs and videos.
- Accident reconstruction calculations, simulations, videos, drawings, and diagrams resulting from my analysis.

My qualifications are detailed in the attached curriculum vitae. A list of all cases in which I have given expert testimony during the last four years is attached. My hourly rate for work in this case is outlined in the attached fee schedule.

Sincerely,

QUEST ENGINEERING & FAILURE ANALYSIS, INC.



G. Bryant Buchner, P.E.
Chief Engineer